

REPORT NO. 6

INDO-POLISH INDUSTRIAL FISHERIES SURVEY ALONG THE NORTH WEST COAST OF INDIA



**PRELIMINARY REPORT OF THE SIXTH CRUISE OF
M. T. MURENA AND SUPPORTING VESSELS
FOR THE PERIOD FROM 28th OCTOBER TO 14th DECEMBER 1977**

**EXPLORATORY FISHERIES PROJECT
(MINISTRY OF AGRICULTURE AND IRRIGATION)
GOVT. OF INDIA
BOMBAY.**

INDO-POLISH INDUSTRIAL FISHERIES SURVEY
ALONG THE NORTH WEST COAST OF INDIA

Preliminary report of the sixth cruise of
M.T.Murena and supporting vessels for the period
from 28th October to 14th December, 1977



By

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APRIL, 1978

EXPLORATORY FISHERIES PROJECT
GOVERNMENT OF INDIA
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INDIA

C O N T E N T S

Page

Participants, participating agencies and
vessel deployed

Advisory Committee on Indo Polish Industrial
Fisheries Resources Survey along the North west coast
of India

Acknowledgements

List of Tables

List of Illustrations

1.	INTRODUCTION	...	1
2.	VESSEL AND GEAR	...	2
3.	PROGRAMME OF WORK OF MAIN AND ANCILLARY VESSELS	...	4
4.	METHODS OF OPERATION	...	5
5.	EXTENT OF DATA COLLECTED	...	6
6.	RESULTS OF OPERATION OF VITH CRUISE OF M.T.MURENA	...	9
6.1.	Relative abundance by area		
6.2.	Catch composition		
7.	RESULTS OF PELAGIC TRAWLING SO FAR DONE BY M.T.MURENA...		14
7.1.	Intensity of sampling		
7.2.	Relative abundance by area		
7.3.	Catch composition		
7.4.	Relative abundance of important groups		
8.	RESULTS OF OPERATION OF ANCILLARY VESSEL	...	29
9.	GENERAL OBSERVATIONS	...	32
10.	REFERENCES ON THE FISHERY RESOURCES ALONG THE NORTH WEST COAST OF INDIA	...	37
11.	APPENDIX		

PARTICIPANTS, PARTICIPATING AGENCIES AND VESSELS
DEPLOYED FOR THE PROGRAMME

Participants	Participating agencies
--------------	------------------------

M.T. MURENA

6th Cruise from 28-10-1977 to 14-12-1977

CAPTAIN

- | | |
|-----------------------------|---------------------------|
| 1. Mr. Dziewiecki Wladystaw | From 28-10-77 to 16-11-77 |
| 2. Mr. P. Jasinski | From 16-11-77 to 14-12-77 |

SCIENTISTS

- | | |
|-------------------------|--|
| 1. Mr. Zaczek Krsysztof | Deputy Master and Ichthyologist
M.T.Murena |
| 2. Mr. Tadeuss Chromics | Oceanographer, M.T.Murena |
| 3. Mr. D. Sudarsan | Deputy Director, Exploratory Fisheries
Project, Calcutta - Cruise Leader from
the Indian side |
| 4. Dr. M.V. Pai | Officer in-charge, Karwar Research
centre of the Central Marine Fisheries
Research Institute, Karwar |
| 5. Mr. P.K. Vijayarajan | Oceanographer, Naval Physical Oceanographic
Laboratory, Cochin |

FISHING TECHNICIANS

- | | |
|-------------------------|--|
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Bombay base, Colaba, Bombay |
| 2. Mr. S.D.Ramachandran | Bosun, Central Institute of Fisheries
Nautical and Engineering Training, Cochin |
| 3. Mr. M.B.Mandvekar | Senior Deckhand, Exploratory Fisheries
Project, Bombay base, Colaba, Bombay |
| 4. Mr. Motis Fernandes | Cook, Exploratory Fisheries Project,
Bombay base, Colaba, Bombay |

M.T. MATSYAVIGYANI

2nd Cruise from 31-10-1977 to 7-11-1977

3rd Cruise from 16-11-1977 to 20-11-1977

4th Cruise from 28-11-1977 to 6-12-1977

5th Cruise from 14-12-1977 to 20-12-1977

SKIPPER

- | | |
|-------------------|--|
| 1. Mr. Martin Vaz | Skipper, M.T.Matsyavigyani, Exploratory
Fisheries Project, Calcutta base,
Calcutta |
|-------------------|--|

SCIENTIST PARTICIPANTS

- | | |
|---------------------------|---|
| 1. Mr. S. Krishna Pillai | Scientists, Bombay Research Centre
of the Central Marine Fisheries |
| 2. Mr. G. Subramanya Bhat | Research Institute, Bombay |

ADVISORY COMMITTEE ON INDO-POLISH FISHERIES RESOURCES SURVEY
ALONG THE NORTH WEST COAST OF INDIA (MINISTRY'S REF. NO. 46-15/
73-FY(B&A)/T-1) DATED 6TH MAY, 1977

- | | |
|---|-----------------|
| 1. Smt. S.L. Singla
Joint Secretary(Fisheries),
Department of Agriculture, New Delhi | CHAIRMAN |
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Integrated Finance,
Ministry of Finance, New Delhi | MEMBER |
| 3. Joint Commissioner(Fisheries),
Department of Agriculture,
New Delhi | MEMBER |
| 4. Secretary,
Forest and Fisheries Department,
Government of Maharashtra, Bombay | MEMBER |
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Agriculture and Co-operation Department,
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Engineering Training, Cochin | MEMBER |
| 8. Director,
Central Institute of Fisheries Education,
Versova, Bombay | MEMBER |
| 9. Nominee of the Bombay Port Trust | MEMBER |
| 10. Nominee of the Ministry of Defence | MEMBER |
| 11. Director,
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Bombay | MEMBER/CONVENOR |

A C K N O W L E D G E M E N T S

In pursuance of the agreement signed at Warsaw on 26th August, 1976 between the Ministry of Foreign Trade and Shipping (Polish People's Republic) and the Ministry of Agriculture and Irrigation (Government of India) the Indo-Polish Industrial Fisheries Survey along the north west coast of India was started from January, 1977. The present report, the sixth in the series, embodies the preliminary results of investigations carried out by M.T. Murena during the sixth voyage from 28th October, 1977 to 14th December, 1977.

We express our sincere thanks to Sri G.V.K.Rao, Secretary, Smt. Anna Malhotra, Additional Secretary, Smt. S.L.Singla, then Joint Secretary (Fisheries), Ministry of Agriculture and Irrigation, Government of India for providing policy guidelines and facilities for the implementation of this programme. Prof. P.C.George, Joint Commissioner (Fisheries) and Sri J.V.H.Dixitulu, then Deputy Commissioner (ET) have taken active interest and provided valuable support and guidance throughout the investigation.

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We are thankful to Sri D.A.S. Gnanadoss, Director, Central Institute of Fisheries Nautical and Engineering Training, Cochin, Dr. S.N.Dwivedi, Director, Central Institute of Fisheries Education, Bombay, Dr. E.G. Silas, Director, Central Marine Fisheries Research Institute, Cochin and Dr. D. Sreenivasan, Director,

Naval Physical Oceanographic Laboratory, Cochin and their colleagues for their valuable support and participation.

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LIST OF TABLES

Table	I	Allocation of sampling effort programmed in each stratum and the results achieved during the VIth cruise of <u>M.T.Murena</u>
Table	II	Area-wise fishing effort, catch and catch/hour obtained by <u>M.T.Murena</u> during her VIth cruise by pelagic trawling
Table	III	The catch composition, catch rates and percentage of each variety in the total catch obtained by pelagic trawling by <u>M.T.Murena</u> during her VIth cruise
Table	IV	Cruise-wise break-up of hauls made, effort put in, catch landed, catch/hour and catch/hour/h.p. obtained by pelagic trawling by <u>M.T.Murena</u>
Table	V	Strata-wise fishing effort, hauls made, catch and catch/hour obtained by <u>M.T.Murena</u> in the course of six cruises by pelagic trawling
Table	VI	Illustration of the two highly productive areas during each voyage undertaken by <u>M.T.Murena</u> in the course of six cruises by pelagic trawling
Table	VII	Area-wise, catch, fishing effort and catch/hour obtained by <u>M.T.Murena</u> by pelagic trawling in the course of six cruises
Table	VIII	Area-wise catch rate in respect of bottom and pelagic trawling by <u>M.T.Murena</u> during all her voyages during 1977 along the north west coast of India
Table	IX	The catch composition, catch/hour and percentage of each variety in the total catch obtained by pelagic trawling along with bottom trawl data obtained by <u>M.T.Murena</u> in the course of six cruises
Table	X	Area-wise catch/hour of important species obtained by <u>M.T.Matsyavigyani</u>
Table	XI	Percentage composition of important species obtained by <u>M.T.Matsyavigyani</u>

LIST OF ILLUSTRATIONS

- Fig. 1. Cruise track of M.T.Murena during her VIth cruise
- Fig. 2. Trawl stations of M.T.Murena - Cruise No.VI
- Fig. 3. Area-wise catch/hour of pelagic trawling by M.T.Murena during her VIth cruise
- Fig. 4. Pelagic trawl stations made by M.T.Murena during her Ist to VIth cruise
- Fig. 5. Area-wise and species-wise catch/hour of pelagic trawling by M.T.Murena during Ist to VIth cruise
- Fig. 6. Area-wise catch/hour of each variety in the total catch obtained by pelagic trawling and bottom trawling in respect of M.T.Murena's voyages during 1977
- Fig. 7. The percentage composition of important categories of fishes in respect of pelagic trawling by M.T.Murena during her Ist to VIth cruise off Goa, Ratnagiri and Bombay regions.
- Fig. 8. The percentage composition of important categories of fishes in respect of pelagic trawling by M.T.Murena during her Ist to VIth cruise off Veraval, Porbandar and Dwaraka

INTRODUCTION

The Indo-Polish Industrial Fisheries Survey Programme along the north west coast of India commenced during January 1977 by deploying a Polish trawler M.T.Murena (69 m) as the main vessel with a few Indian vessels as supporting ones and concluded the operations in December 1977. During this period from January to December 1977, the survey programme was carried out under six voyages by the main vessel to provide information on the identity and size of the major stocks and their exploitable level, the main pattern of distribution and their general life history and behaviour and every effort was made to survey the pelagic, columnar and demersal fishery resources from latitude 15° N to 23° N in depth ranges 30 -~~X~~200 fathom. The results of operations of the first five cruises have already been published at periodical intervals by Exploratory Fisheries Project in the form of preliminary reports. The present report is the sixth in the series which embodies the results of operation of the sixth and final cruise of M.T.Murena and ancillary vessels. An attempt has also been made to evaluate the survey programme as a whole as well as to high-light the salient features of commercially exploitable stock available between the depth ranges 30-200 fathom along the north west coast of India.

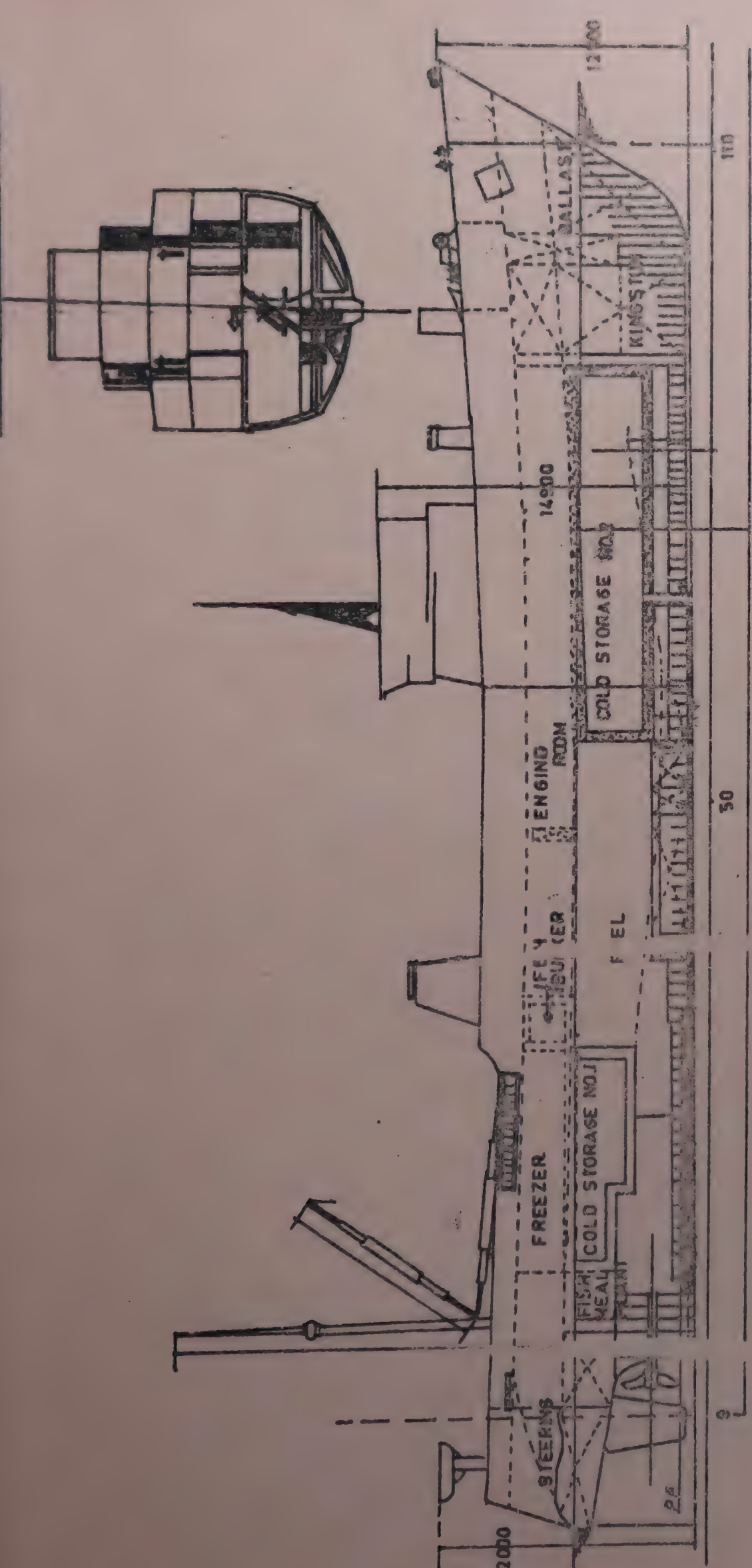
The sixth cruise of M.T.Murena under review commenced on 28-10-1977 and concluded on 14-12-1977. In between the vessel called at Bombay Port on 16-11-1977 and remained there upto 25-11-1977 for change of polish crew members. Since the survey was restricted only to one year, there were bound to be gaps in our knowledge and it is felt

that the next task would be to identify those gaps and resort to measures to fill up the information that was lacking. The preliminary reports released by the Exploratory Fisheries Project under this series after the completion of each cruise had already reached the end users. It is evident that the survey had been of immense use as it gave much information on the resources position of the deeper waters along the north west coast of India and also helped to assess the economic viability of commercial exploitation of the same.

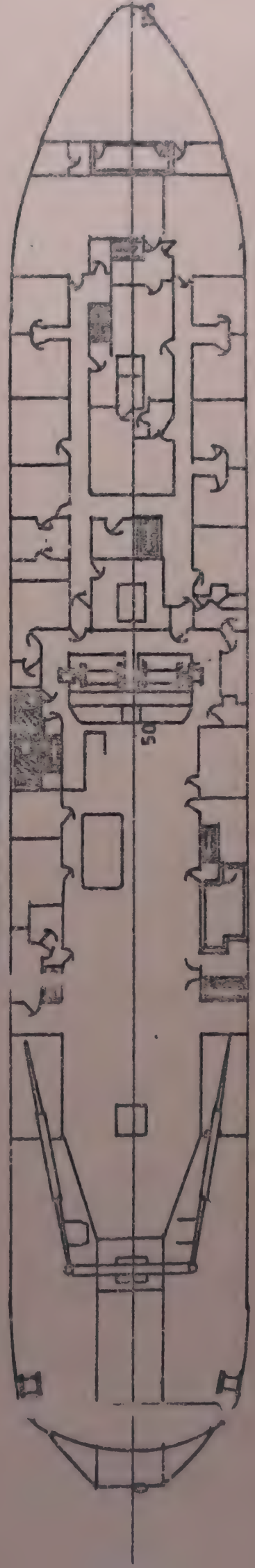
2. VESSEL AND GEAR

As reported earlier M.T.Murena is a stern trawler of 69 m O.A.L. having a propulsion engine of 1620 B.H.P. The after deck with its stern ramp is clearly laid out for stern trawling operations both for bottom and pelagic trawling (see general arrangement drawing). An electrically operated trawl winch of 12 tons pulling capacity is fitted at midship under the covered deck. The catch is unloaded by untying the cod end into the aft fish hold hatch. From there the catch is washed, sorted and frozen in the processing plant and the frozen product is packed and transferred to refrigerated fish holds by means of conveyor-belt system. On board, processing facilities include two plate freezers of freezing capacity 12 tons/day and a fish meal plant with capacity of 2 tons fish meal/day. The fish hold can store 600 m^3 of frozen fish and 46 m^3 of fish meal. There is accommodation for 44 crew. The vessel has an endurance of 50 days. Fresh water system is supported by a storage tank of 60 T capacity and a water desalinator of capacity 5 tons/day. The ice plant on board can produce upto five tons flake ice per day.

SECTION ON FROM 40 LOOKING FOR



PROFILE OF M.I. MURENA



LAY OUT OF UPPER DECK

The capability of the vessel is properly strengthened by electronic equipments for navigation and fish finding. The important electronic equipments available on board were:

1. Gyro compass with repeaters
2. Marine radar
3. Decca navigator
4. Radio Station with radio telephone and wireless sets
5. Net Sonde - Make ELAC
6. Sonar
7. Echo sounder - dry paper type

The net sonde or 'trawl eye' has been consistently very dependable and useful being able to detect the occurrence of columnar stocks and thus helping successful mid water trawl operations. (Please see plate showing the echogram). The vessel carried on board 6 Nos. pelagic trawls and 6 Nos. bottom trawls.

The line-up of the polish crew was as follows:-

Designation	No.of posts	Designation	No.of posts
Captain	1	Electrical Engineer	1
Chief Engineer	1	Refrigeration Engineer	1
Ist officer	1	Assistant Engine Drivers	3
2nd officer	1	Technologists	2
3rd officer	1	Fish Meal plant operators	2
Radio officer	1	Senior Deckhands	
Senior Deckhands	9	(Processing)	5
IInd Engineer	1	Chief Cook	1
IIIrd Engineer	1	Assistant Cooks	2

The supporting vessel 'Matsyavigyani' is a stern trawler of 32.2 m O A L with an engine of 575 BHP. With the wheel house located forward, the aft deck is free for fishing operations. A hydraulic winch of six tons pull and winch drum ^{capacity of} 900 fathoms wire rope is located after the fish hold.

M.T.Murena operated pelagic trawl and pelagic rope trawl during the cruise, while Matsyavigyani operated 45 m bottom trawl. The designs and specifications of the nets operated by M.T.Murena have already been given in earlier reports.

3. PROGRAMME OF WORK OF MAIN AND ANCILLARY VESSELS

In the pre-cruise meeting, decision was taken to cover the ten zones of survey area using pelagic trawls. A standard pelagic survey station consisted of a bathy thermograph cast and a plankton sample followed by a haul with the survey trawl. 50 obligatory hauls comprising 5 hauls in each zone were to be made and the remaining 100 extra hauls were programmed for intensive fishing.

It was decided to collect plankton samples by using Indian ocean standard plankton nets and sediment samples by using Peterson grab at selected stations. Biological data of a few commercially important varieties of fishes were also to be studied by the Ichthyologists on board the vessel. Oceanographic study programme included estimation of temperature, salinity and dissolved oxygen at varied depths using Nansen bottles and bathythermograph. Observation on the meteorological conditions of the survey area were also to be made.

SHOAL

HEAD ROPE

Fig. 1.

Haul no. 70.

22.03.77

area 28.

Depth: 60-69 m

22° 35' N

68° 04' E

22° 25' N

68° 16' E

Effort 5 h

Total catch 5,945 kg

T. haumela 3,500

P. niger 1,600

Sharks 300

ECHOGRAM OF NET RECORDER

The ancillary vessel M.T.Matsyavigyani was programmed to operate in close vicinity of M.T.Murena using bottom trawls during the above period. Studies of oceanography and biology of some commercially important species were programmed to be carried out by scientists deputed on board the vessel. The exploratory programme of work in respect of M.T.Matsyavigyani is furnished below:-

Name of vessel	Duration of voyage	No.of days	Purpose
<u>M.T. MATSYA- VIGYANI</u>	31-10-77 to 7-11-77	8	Exploratory bottom trawling between 30-60 m in strata 4, 7 and 10
	16-11-77 to 20-11-77	5	Exploratory bottom trawling between 45-70 m in strata 7 and 10
	28-11-77 to 6-12-77	9	Exploratory bottom trawling between 45-85 m in strata 10, 13 and 16
	14-12-77 to 20-12-77	7	Exploratory bottom trawling between 55-115 m in strata 4,7,8, 10 and 11

4. METHODS OF OPERATION

The methodology adopted for the survey of columnar and pelagic resources, study of biological characteristics of some of important species and collection of oceanographic and meteorological parameters in the survey area have already been discussed in the earlier reports of the series. These were followed without any variation during the present cruise also. Thus to ensure proper and uniform recording of all observations the data were collected

during all the voyages in separate standard data sheets. For environmental data hydro master card / code 01 / and hydro depth card / code 03 / B.T. master card / code 04 / and B.T. detail card / code 05 / were used. A separate log was prepared for plankton. Sampling for trawl catch data was recorded in 1. Demersal and pelagic catch forms- 2. Length frequency information- 3. Length/maturity information- 4. Age frequency forms.

It may be mentioned that the entire data collected during the six voyages of M.T.Murena has been processed in the manner referred to above. Copies of standard data sheets are presented as Appendix I to VIII of this report with the hope that it might prove useful to the scientific workers engaged in the Biological/Oceanographic investigations in tropical waters.

5. EXTENT OF DATA COLLECTED

The area under investigation was covered by 136 hauls which included 50 obligatory hauls and 86 extra hauls using pelagic trawl and pelagic rope trawls. Table 1 gives the allocation of sampling effort programmed and results achieved during the sixth cruise of M.T.Murena. The composition of catch and the catch/hour were worked out for each zone. Plankton samples were collected from 133 stations by vertical hauls using Indian Ocean Standard nets. The samples collected are being analysed at shore laboratory. Bottom sediments were collected from 41 stations using Peterson grab and the same also are being analysed at the shore laboratory. Temperature, salinity and dissolved oxygen values were estimated at varied depths using Nansen cast and bathy thermograph cast made from 135 stations. Meteorological observations such as humidity, wind speed, velocity and direction of current, state of sea and sky in the survey area were also recorded from each survey station.

TABLE I. Allocation of sampling effort programmed in each stratum and the results achieved during the sixth cruise of M.T.Murena

Zone No.	Strata	Area (sq.km)	Number of hauls programmed	Number of hauls made
1	1	1,140	4	7
	2	602	—	3
	3	835	3	3
2	4	2,370	8	7
	5	746	—	2
	6	1,176	7	3
3	7	967	6	7
	8	1,791	9	2
	9	286	1	2
4	10	3,504	10	8
	11	1,856	9	2
	12	358	1	2
5	13	4,280	14	15
	14	1,110	6	2
	15	364	—	1
6	16	4,095	15	14
	17	519	—	2
	18	519	2	2
7	19	2,131	12	7
	20	397	—	1
	21	501	—	1

contd...

(Table I. contd..)

Zone No.	Strata	Area (sq.km)	Number of hauls programmed	Number of hauls made
8	22	1,002	8	4
	23	280	2	6
	24	531	-	-
9	25	1,492	4	5
	26	811	1	2
	27	1,020	10	2
10	28	1,134	5	15
	29	1,415	12	6
	30	835	9	3
<hr/>				
Total:		38,067	158	136
<hr/>				

Biological data on length, weight, sex, maturity and stomach contents were also collected in respect of Megalaspis cordyla, Trichiurus haumela, Pampus argenteus, Parastromateus niger, Scomberomorus guttatus, S. commerson, Auxis thazard, Echeneis neucrates, Sarda orientalis, Rastrelliger kanagurta, Pseudosciaena diacanthus, Pomadasys hasta, Muraenesox sp. and Caranx malabaricus. Specimens of interest as well as scales and otoliths of some of the species were also preserved and removed for detailed analysis in the shore laboratory.

6. RESULTS OF OPERATION OF SIXTH CRUISE OF M.T.MURENA

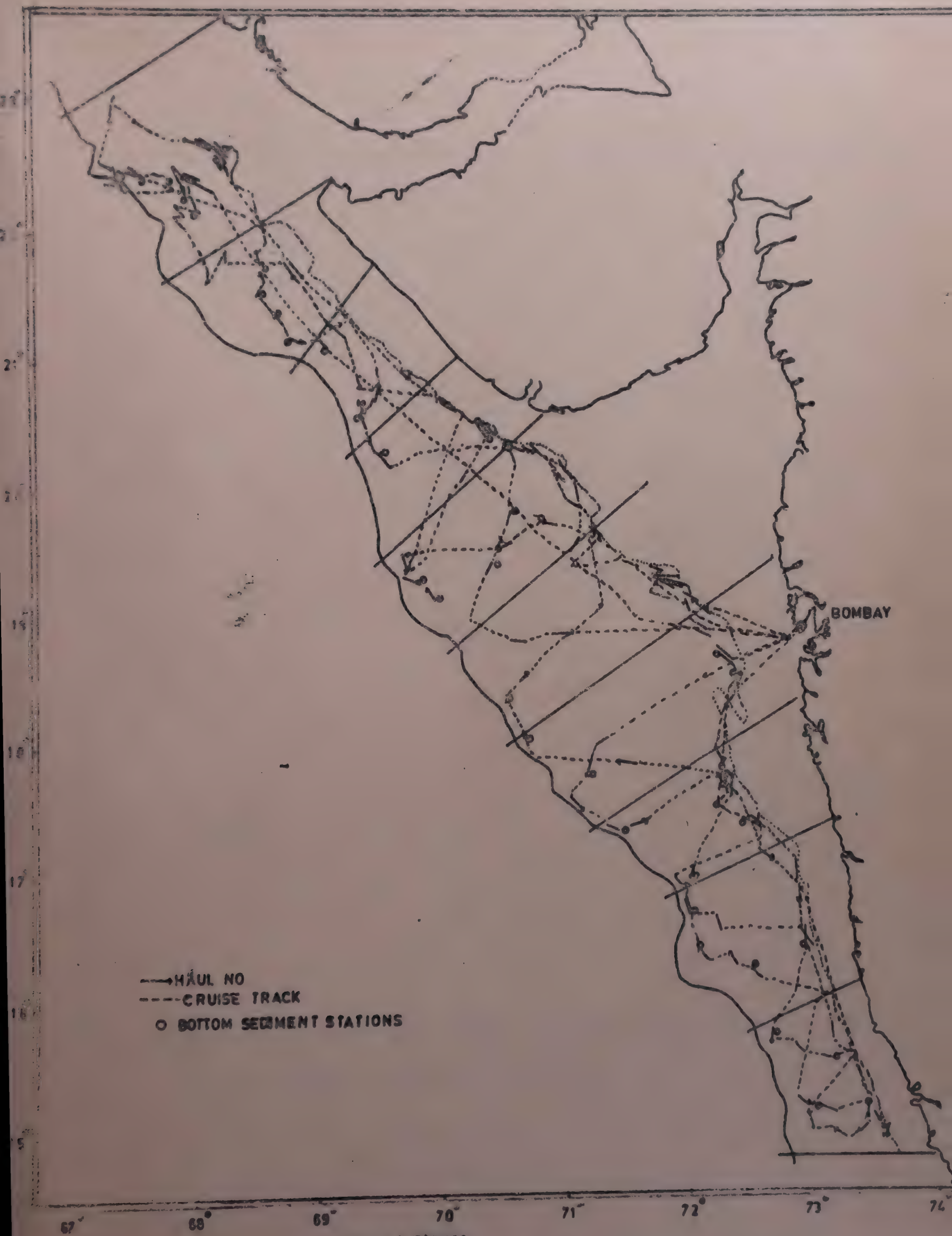
During the cruise, the vessel conducted 36 days of survey operation expending 232.17 hours of actual fishing using pelagic trawl and pelagic rope trawl and landed 68.1 tons of catch. The cruise track of M.T. Murena during her sixth voyage is given in Fig. 1. The catch/hour, catch/hour/h.p. and catch/day obtained during the entire cruise were 293.23 Kg, 0.18 Kg and 1891 Kg respectively.

The location of 136 pelagic trawl stations are given in Fig. 2. As was done in the earlier reports, the results obtained during the present cruise also have been analysed for each major square and a study on the fluctuations of the major exploitable fish stocks for the six sub-regions viz. Goa, Ratnagiri, Veraval, Bombay, Porbandar and Dwaraka has been attempted.

6.1. Relative abundance by area: It can be seen that 20 major squares of the area of investigation have been surveyed during the sixth cruise. Table II gives the details of fishing effort expended, catch and catch/hour obtained from major squares by M.T.Murena during her sixth cruise. The areas extensively surveyed in order were 19-71 (31 hrs), 22-67 (27 hrs), 20-70 (21 hrs), 22-68 (19 hrs), 21-68 (17 hrs), 15-73 (17 hrs), 20-69 (16 hrs), 17-72 (15 hrs) and 16-72 (12 hrs). The effort put in for surveying the rest of the areas was less than 10 hours.

The highest catch/hour of 843 Kg was obtained from the area 19-71 off Bombay. The next highest catch rate of 580 Kg/hour was recorded from the area 20-70 off Veraval. The area 20-71 off Veraval also recorded a comparatively better catch rate of 477 Kg/hour. Three areas which recorded catch rates between 300-400 Kg/hour were 22-67 (370 Kg/hr) and 22-68 (352 Kg/hr) both off Dwaraka and 16-73 (346 Kg/hr) off Ratnagiri. The deeper areas off Bombay (18-71, 18-70, 19-69) and off Porbandar (21-69) yielded comparatively very poor catch rates. The areawise catch rate of different squares in respect of M.T.Murena's sixth cruise is presented in Fig. 3.

6.2. Catch composition: The catch/hour obtained for different species from the entire survey area and the percentage of each variety in the total catch based on the sixth cruise is given in Table III. It can be seen from the table that Ribbon fish (Trichiurus lineatus) constituted the bulk of the catch with 37% of the total. The catch/hour obtained for this species was 108 Kg.



SCALE 1:1779000
FIG 1 CRUISE TRACK CRUISE NO 6 M T MURENA

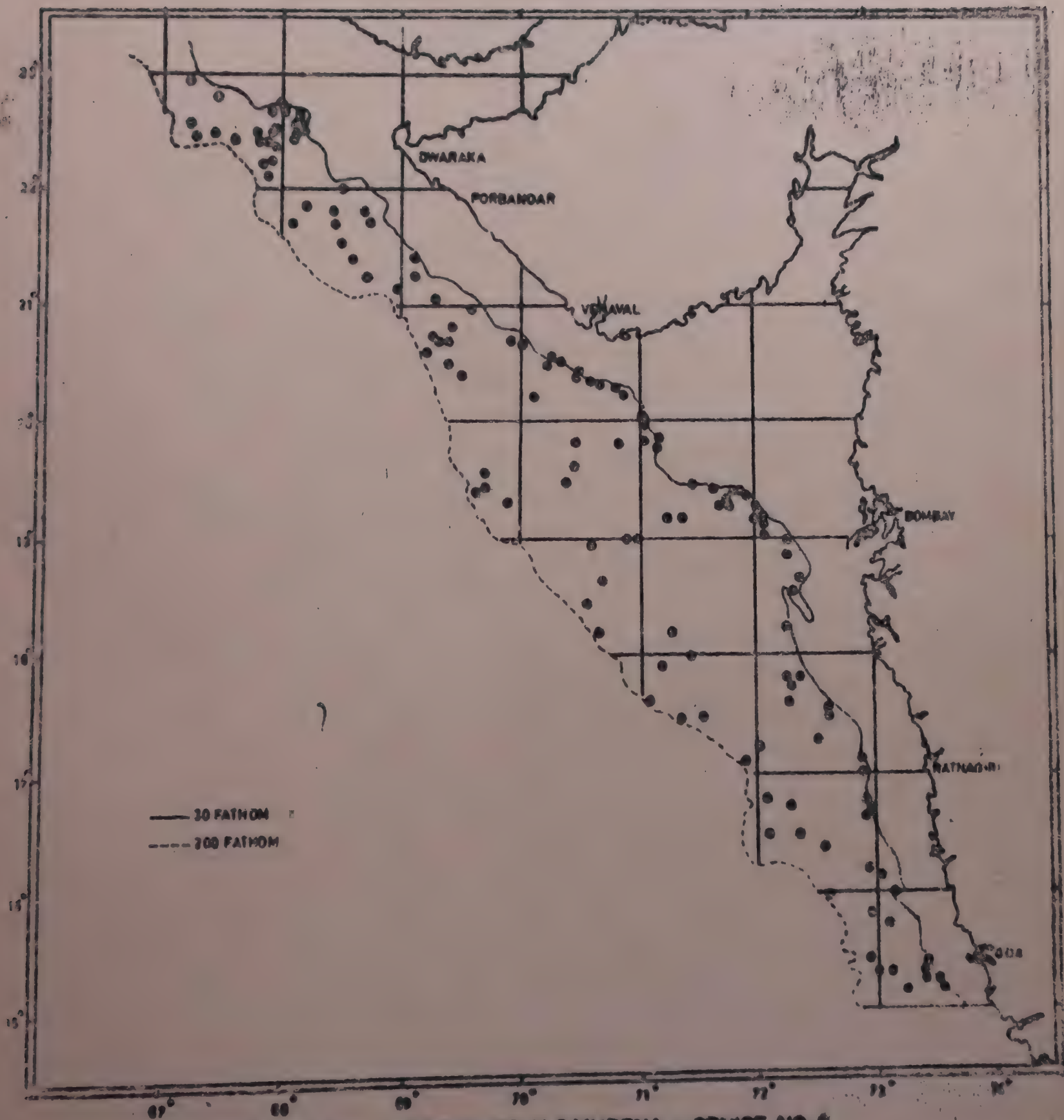


FIG. 2 TRAWL STATIONS OF H.T. MURENA - CRUISE NO. 6

TABLE II. Area-wise fishing effort, catch and catch/hour obtained by M.T.Murena during her VIth cruise by pelagic trawling

Area	Fishing effort (hrs)	Total catch (Kg)	Catch/hour (Kg)
15-72	4.50	31	6.89
15-73	16.50	1,271	77.03
16-72	12.33	838	67.96
16-73	3.30	1,141	345.76
17-71	9.00	110	12.22
17-72	15.33	2,572	167.78
18-70	7.67	135	17.60
18-71	1.67	2	1.20
18-72	9.00	1,489	165.44
19-69	6.00	64	10.67
19-70	7.50	237	31.60
19-71	30.70	25,880	843.00
19-72	3.50	987	282.00
20-69	15.83	2,066	130.51
20-70	21.17	12,268	579.50
20-71	2.00	954	477.00
21-68	17.00	1,280	75.29
21-69	3.00	12	4.00
22-67	27.17	10,045	369.71
22-68	19.00	6,697	352.47
Total/ Average	232.17	68,079	293.23

TABLE III. The catch composition, catch rates and percentage of each variety in the total catch obtained by pelagic trawling by M.T.Murena during her VIth cruise

Name of species	Catch (Kg)	Percentage	Catch/hour (Kg)
Ribbon fish	25,104	36.9	108.1
Horse mackerel	7,197	10.6	31.0
Sharks and skates	6,387	9.4	27.5
Pomfret	5,855	8.6	25.2
Cat fish	4,732	7.0	20.4
Rays	3,078	4.5	13.3
Ghol	2,943	4.3	12.7
Surmai	1,841	2.7	7.9
Eel	1,679	2.5	7.2
Dhoma	1,320	1.9	5.7
<u>Caranx</u> spp .	1,322	1.9	5.7
Karkara	1,083	1.6	4.7
Perch	822	1.2	3.5
<u>Chorinemus</u> spp	749	1.1	3.2
<u>Polynemus</u> spp	106	0.2	0.5
Barracuda	123	0.2	0.5
Rani fish	137	0.2	0.6
Squid	68	0.1	0.3
Prawn	92	0.1	0.4
Tuna	79	0.1	0.3
<u>Pellona</u> sp.	62	0.1	0.3
<u>Lactarius</u> spp	2	0.0	0.0
Mackerel	35	0.0	0.2
Others	3,239	4.8	14.0
Total/Average	69,079	100.0	293.2

Though 39% of the total catch was constituted by Ribbon fish during the fifth voyage, the catch rate recorded then was a mere 11 kg/hr for this species. The next important species netted was horse mackerel 11% with a catch rate of 31 kg/hr. Shark and skate contributed 10% of the catch with a catch rate of about 28 kg/hr. Pomfret amounted for 9% of the total catch with a catch rate of 25 kg/hr. The percentage composition of cat fish was 7 with a catch rate of 20 kg/hr. Contribution of other important groups were Rays 5%, Ghol 4%, Surmai 3% and eel 3%.

Regionwise catch rates of pelagic trawling obtained by M.T.Murena during her sixth cruise is presented below. It is seen from the table that Bombay region yielded the highest catch and highest catch rate of 28794 Kg and 436.20 Kg/hr respectively. Veraval yielded the next best catch rate of 393.71 Kg/hr, Dwaraka following very closely with 362.61 Kg/hr. Goa in the southern zone and Porbandar in the northern zone recorded the minimum catch rates with 62 kg/hr and 64.60 kg/hr respectively.

Region	Fishing effort(hrs)	Catch(Kg)	Catch/hr(Kg)
Goa	21.00	1302	62.00
Ratnagiri	40.16	4661	116.06
Bombay	66.01	28794	436.20
Veraval	38.83	15288	393.71
Porbandar	20.00	1292	64.60
Dwaraka	46.17	16742	362.61
Total/Average	232.17	68079	293.22

7. RESULTS OF PELAGIC TRAWLING SO FAR DONE BY M.T.MURENA

An attempt has been made in Report No.5 to consolidate the findings in order to evaluate the demersal fishery resources of the north west coast of India based on Murena's work during 1977. It is hoped that the following chapters will throw some light on the pelagic fishery resources based on data collected.

The~ cruise-wise details are presented below (data in respect of pelagic and bottom trawling combined) to show the performance and the results achieved.

Particulars	Cruise No.1	Cruise No.2	Cruise No.3	Cruise No.4	Cruise No.5	Cruise No.6	Total for all six cruises
Fishing days	34	40	30	43	35	36	218
Fishing hours	215.25	313.92	238.32	227.04	237.00	232.17	1463.70
Total catch (Kg)	48,130	2,42,493	1,07,103	24,412	18,646	68,079	5,08,863
Catch/hr (Kg)	223.60	772.47	449.41	107.54	78.68	293.23	347.66
Catch/hr/h.p.(Kg)	0.14	0.48	0.28	0.07	0.05	0.18	0.21
Catch/day (Kg)	1416	6062	3570	568	533	1891	2334

It is seen that M.T.Murena made a total of 218 days of fishing expending about 1464 hours during the course of six voyages in 1977 and landed about 509 tonnes of fish. The catch/hr, catch/hr/h.p. and catch/day for all the six cruises combined irrespective of gear employed worked out to 348 Kg, 0.21 Kg and 2,334 Kg respectively.

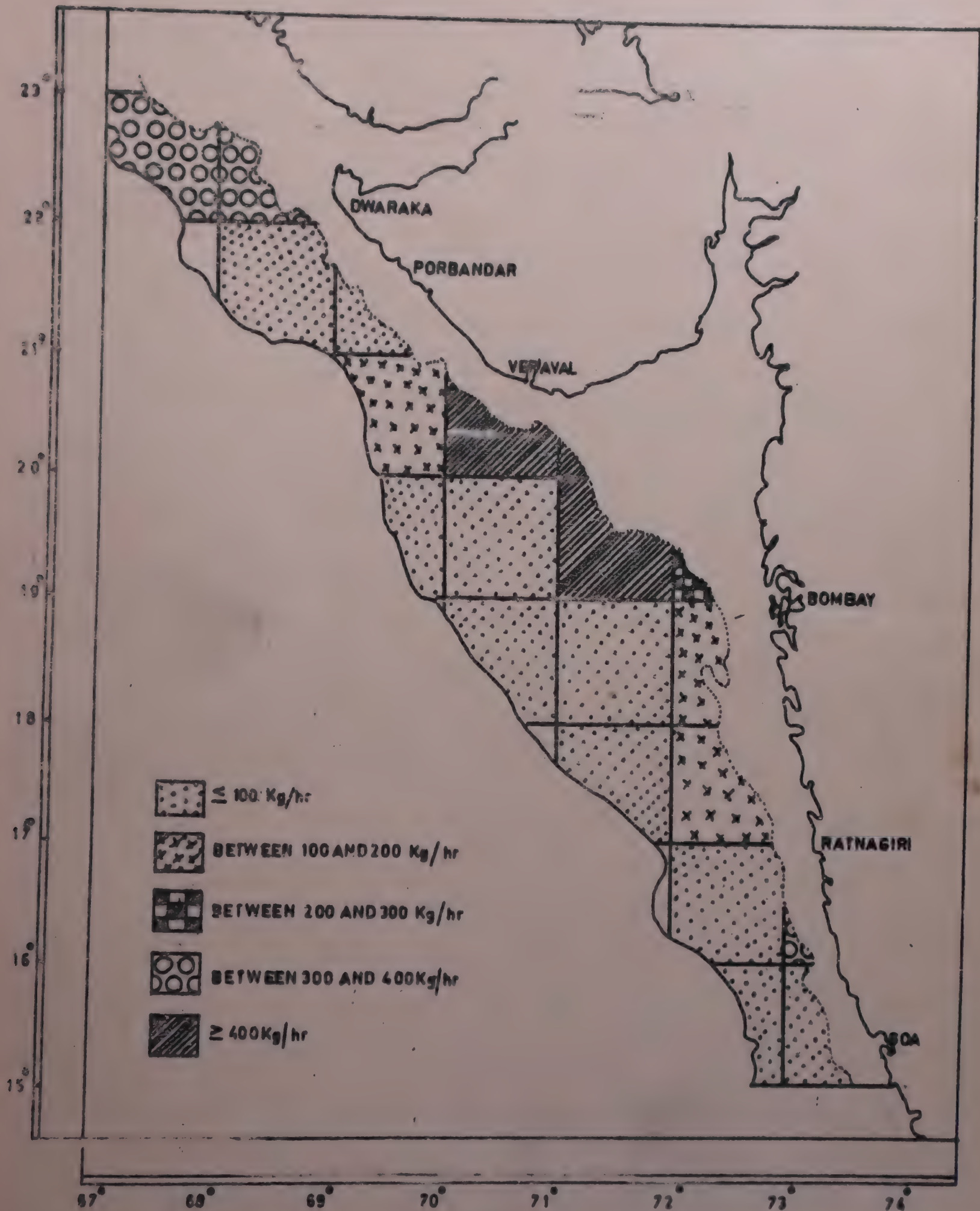


FIG 3 AREA WISE CATCH PER HOUR OF PELAGIC TRAWLING BY, M.T. MURENA DURING HER 6th CRUISE

Though it was envisaged to operate exclusively bottom trawls and pelagic trawls in alternate cruises of M.T.Murena this could not be strictly adhered to since the bottom conditions in certain regions did not permit the operation of bottom trawls. Consequently, pelagic trawl was operated partially during the bottom trawl cruise Nos. 1, 3 & 5 apart from its exclusive operation during the pelagic trawl cruise Nos. 2, 4 and 6. The details of pelagic trawl hauls made during each cruise, the fishing effort expended, catch and catch/hour obtained in each are given in Table IV. Fig. 4 also gives the trawl stations made by M.T.Murena during her first to sixth voyages.

It can be seen that during the entire survey programme 543 hauls were made using pelagic trawl and pelagic rope trawl. Total fishing effort expended in pelagic trawling was 1065 hours and about 436 tons of fish was landed during the course of survey. The average catch/hour worked out to 410 Kg and catch/hour/h.p. obtained was 0.25 Kg. The overall catch rates during the different cruises varied from as low as 26.67 Kg/hr to 834.2 Kg/hr. The average catch/hour obtained during the second cruise of M.T.Murena was 834 Kg and it may be mentioned that certain productive areas for horse mackerel and pomfrets were located during this cruise. The areas 22-68, 20-69, 22-67, 19-69 and 15-73 yielded very high catch rates ranging between 460 Kg/hr and 1840 Kg/hr (Report No.2). The results of operation of the second cruise has clearly indicated that there is ample scope for mid water trawling along the north west coast during the period from February to April. Subsequent observations have indicated that the period from the end of October till the end of May corresponding to cruises 6, 1, 2 and 3 appears to be fairly productive for pelagic trawling operations.

TABLE IV. Cruise-wise break-up of the hauls made, effort put in, catch landed, catch/hour and catch/hour/h.p. obtained by pelagic trawling by M.T.Murena

Cruise of No.	Number hauls made	Fishing effort expended (hrs)	Total catch landed (Kg)	Catch/ hour (Kg)	Catch/hour/h.p. (Kg)
1	29	65.13	17,149	263.30	0.16
2	121	284.19	2,37,058	834.20	0.51
3	64	157.74	86,965	551.32	0.34
4	127	227.04	24,412	107.54	0.07
5	66	98.83	2,636	26.67	0.02
6	136	232.17	68,079	293.23	0.18
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Total:	543	1065.10	4,36,299	409.53	0.25

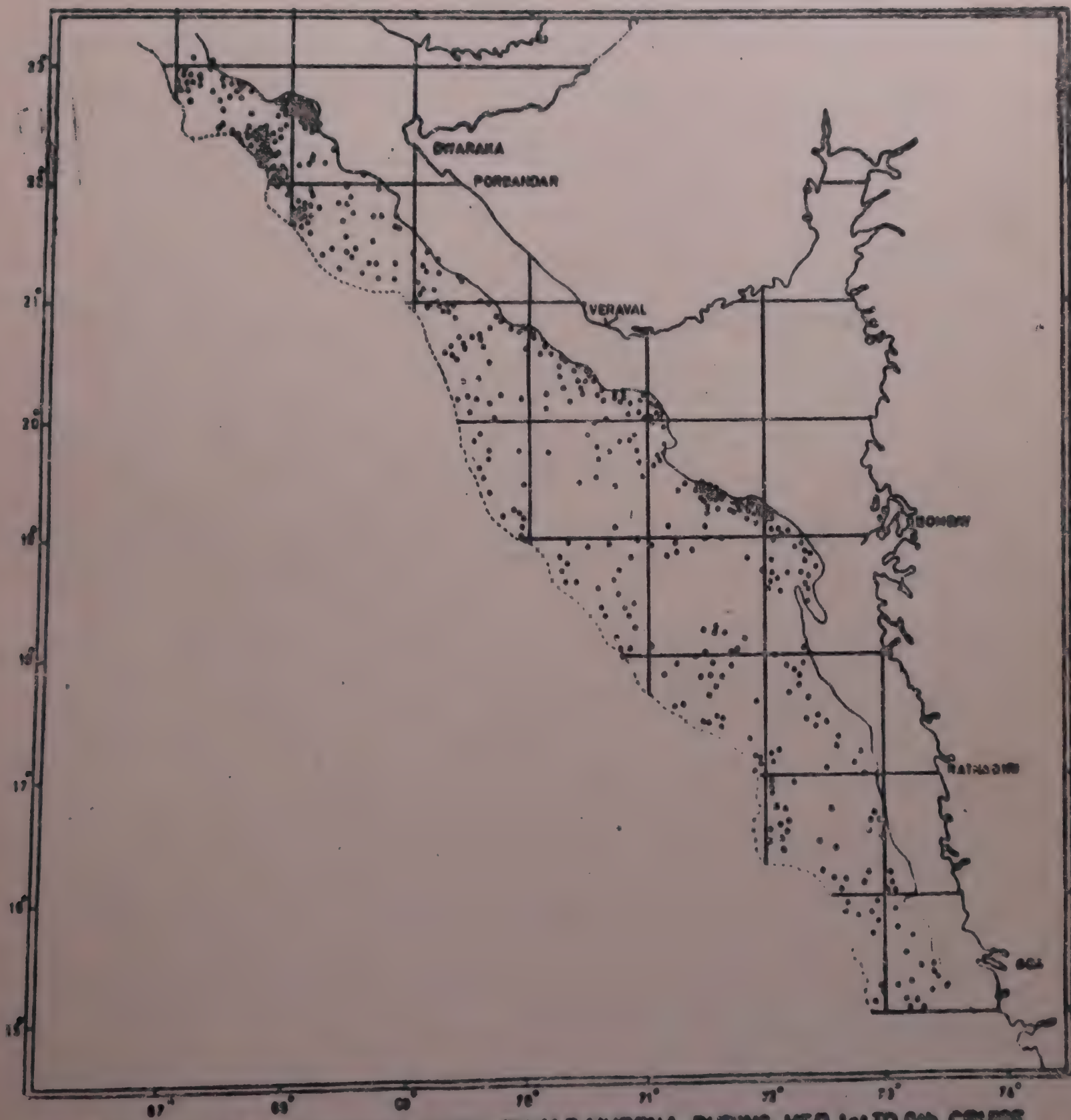


FIG. 4 PELAGIC TRAWL STATIONS MADE BY H.T. MURENA DURING HER 1st TO 6th CRUISE

7.1. Intensity of sampling:

As already discussed in earlier reports the area of survey lying between 30-200 fathoms depth contours from 15°N to 23°N Lat. is divided into ten sampling zones for the purpose of pelagic survey programme. The ten sampling zones are further sub-divided into 30 strata for clarity of presentation and easy analysis. Table V gives the strata-wise fishing effort, hauls made, catch and catch/hr obtained by M.T.Murena in the course of six cruises by pelagic trawling. The strata 13, 28 and 16 were intensively surveyed by putting more than 100 hours of actual fishing. The fishing effort expended in strata 10, 19, 22 and 29 were between 50 and 100 hours. In the remaining strata the intensity of sampling ranged between 5 hours and 45 hours of fishing. High catch rates of 1357 Kg/hr was recorded from the stratum 29 off Dwaraka, Zone X (51-70 fm) followed by stratum 21 off Veraval, Zone VII (71-200 fm) with a catch rate of 820 Kg/hr. Comparatively higher catch rates were also recorded from stratum 30 off Dwaraka (71-200 fm) with 759 kg/hr, 28 off Dwaraka (30-50 fm) with 629 Kg/hr, 13 off Bombay (30-50 fm) with 528 kg/hr and 19 off Veraval (30-50 fm) with 407 Kg/hr. Of the remaining strata the catch/hr ranged between 5 Kg/hr and 400 Kg/hr.

7.2. Relative abundance by area:

Table VI indicates the two areas which have recorded the high catch rates during the different voyages undertaken so far in respect of pelagic trawling.

Table VII illustrates the areawise catch, fishing effort and catch/hr obtained by M.T.Murena by pelagic trawling in the course of six cruises.

TABLE V

Strata-wise fishing effort, hauls made, catch and catch/hour obtained by M.T. Murena in the course of six cruises by pelagic trawling

Zone	Strata No.	No. of hauls made	Fishing effort (hrs)	Catch (kg)	Catch/hr (Kg)
I	1	16	28.32	5,708	201.55
	2	8	14.08	194	13.73
	3	6	10.33	54	5.23
	4	17	31.66	2,160	68.22
	5	6	9.58	520	54.28
	6	17	29.90	549	18.36
III	7	13	19.83	3,332	168.03
	8	8	14.49	260	17.94
	9	5	8.91	209	23.46
IV	10	36	72.55	28,042	303.82
	11	14	22.66	229	10.11
	12	6	10.16	68	6.69
V	13	61	145.15	76,709	528.48
	14	11	18.50	398	21.51
	15	4	6.99	396	56.55
VI	16	48	100.31	38,998	388.77
	17	4	6.32	426	67.41
	18	7	11.00	2,340	212.73
VII	19	29	68.31	27,792	406.85
	20	3	5.24	299	57.06
	21	6	10.99	9,016	820.38

contd...

(TABLE V... contd..)

Zone	Strata No.	No. of hauls made	Fishing effort (hrs)	Catch (kg)	Catch/hr (kg)
VIII	22	20	49.98	3,868	94.39
	23	15	26.23	6,710	255.81
	24	6	9.49	308	32.46
IX	25	15	27.06	2,159	79.79
	26	11	17.99	189	10.51
	27	21	32.73	1,729	52.83
X	28	58	144.03	90,575	628.86
	29	46	78.67	1,06,719	1,356.54
	30	26	42.64	32,343	758.51
Total/ Average		543	1065.10	4,36,299	409.63

TABLE VI. Illustrating the two highly productive areas during
each voyage undertaken by M.T.Murena in the course
of six cruises by pelagic trawling

Voyage/Period	Area:Region	Catch/hour (Kg)
1st voyage	21-69 Porbandar	541
January/February '77	23-67 Dwaraka	476
2nd voyage	22-67 Dwaraka	1838
February/April '77	19-69 Bombay	1138
3rd voyage	19-70 Bombay	895
April/May '77	22-68 Dwaraka	804
4th voyage	18-72 Bombay	850
June/August '77	18-71 Bombay	304
5th voyage	20-69 Veraval	527
September/October '77	18-71 Bombay	100
6th voyage	19-71 Bombay	843
October/December '77	20-70 Veraval	580

TABLE VII Area-wise catch, fishing effort and catch/hour
obtained by M.T.Murena by Pelagic trawling in
the course of six cruises

Area	Fishing effort (hrs)	Total catch (kg)	Catch/hr (kg)
15-72	12.83	73	5.69
15-73	36.41	5,009	137.57
16-72	54.73	2,727	49.83
16-73	7.50	1,143	152.40
17-71	39.73	630	15.86
17-72	33.25	3,143	94.53
18-70	39.00	1,011	25.92
18-71	27.78	4,177	150.36
18-72	37.55	14,518	386.63
19-69	22.57	7,565	335.18
19-70	30.00	1,040	34.67
19-71	141.12	80,539	570.71
19-72	17.49	4,760	272.16
20-69	71.98	23,628	328.26
20-70	84.47	34,422	407.51
20-71	23.49	11,847	504.34
21-67	1.33	40	30.08
21-68	79.30	3,485	43.95
21-69	37.08	6,271	169.12
22-67	188.79	187,238	991.78
22-68	68.04	40,295	592.23
23-67	10.71	2,738	255.65
Total/ Average	1065.15	4,36,299	409.63

Fig. 5 also represents the catch/hour of M.T.Murena by pelagic trawling in the different geographical divisions surveyed in the course of six cruises. It can be seen from the Table VII that 22 major squares have been surveyed. From this table, it is evident that the most intensively surveyed areas in their order are 22-67 off Dwaraka (189 hrs) and 19-71 off Bombay (141 hrs). The fishing effort expended in areas 16-72, 20-69, 20-70, 21-68 and 22-68 ranged between 50 hours and 100 hours. In all the other areas surveyed the fishing effort expended ^{was} ~~were~~ less than 40 hours.

Of the 22 areas surveyed by M.T.Murena by pelagic trawling, the area 22-67 off Dwaraka excelled with a catch rate of 992 Kg/hr. The second highest catch rate of 592 Kg/hr was recorded from 22-68 of the same region i.e. off Dwaraka. Comparatively better catch rates were also recorded from 19-71 off Bombay (571 Kg/hr), 20-71 off Veraval (504 Kg/hr). Generally speaking the areas off Dwaraka yielded higher catch rates compared with that of other regions.

A reference may be made here that the highest catch rates in the order of abundance recorded by M.T.Murena in respect of bottom trawling undertaken by that vessel during 1977 were 19-71 off Bombay (369 Kg/hr), 22-68 off Dwaraka (285 Kg/hr), 20-70 off Veraval (272 Kg/hr) and 21-69 off Porbandar (261 Kg/hr). Areawise catch/hour in respect of bottom and pelagic trawling by M.T.Murena during her voyages in 1977 is presented in Table VIII for comparison.

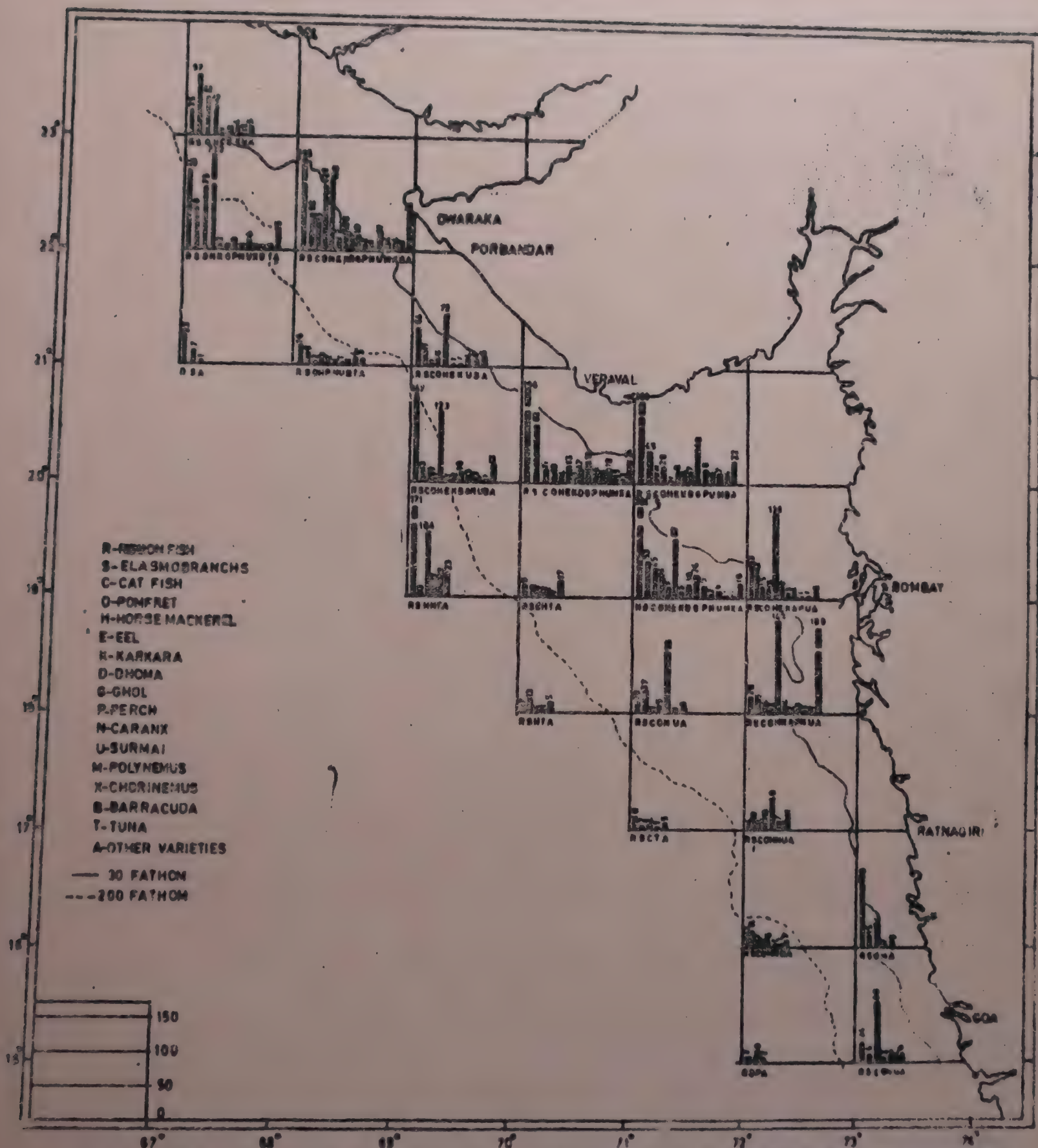


FIG.5 AREA-WISE AND SPECIES WISE CATCH PER HOUR OF PELAGIC TRAWLING BY M.T.MURENA DURING 1st TO 6th CRUISE

TABLE VIII Area-wise catch rate in respect of bottom and pelagic trawling by M.T.Murena during all her voyages in 1977 along the north west coast of India

Area	Bottom trawling (Kg/hr)	Pelagic trawling (Kg/hr)
15-72	123	6
15-73	191	138
16-72	113	50
16-73	53	152
17-71	77	16
17-72	133	95
17-70	60	26
18-72	178	387
18-71	246	150
18-70	43	-
19-71	369	571
19-69	55	335
19-70	165	35
19-72	209	272
20-71	230	504
20-70	272	408
20-69	258	328
21-69	261	169
21-68	199	44
21-67	-	30
22-68	285	592
22-67	15	992
23-67	-	256
Average:	182	410

7.3. Catch composition: The percentages of different groups of commercially important fishes in the total catch and their respective catch/hour recorded during the entire pelagic trawl surveys along with the data collected during bottom trawling are furnished in Table IX and Fig. 6. List of commercially important species with scientific as well as local names occurring in the trawl catches along the six regions on the north west coast has already been presented in the earlier reports.

It can be seen that horse mackerel and ribbon fish were the most predominant species in pelagic trawling with 39% and 28% respectively whereas for bottom trawling ribbon fish(34%) and elasmobranchs (12%) were the abundant groups in the catches obtained. The percentage of elasmobranchs, pomfret, eel and cat fish in the total catch in respect of pelagic trawling were 8%, 7%, 3% and 3% respectively. The percentage composition of important categories of fishes in respect of pelagic trawling by M.T. Murena along the six regions viz. Goa, Ratnagiri, Bombay, Veraval, Porbandar and Dwaraka are given in Fig.7 and 8.

Cat fish accounted for about 60% of the total catch from Goa region, the second highest being ribbon fish with 18%. Elasmobranchs, pomfret, Caranx sp. and seer fishes together constituted 13% of the total catch. It is interesting to note that the most predominant groups in respect of bottom trawling along the Goa region was ribbon fish (43%), cat fish (19%) and rani fish (Nemipterus sp. 13%).

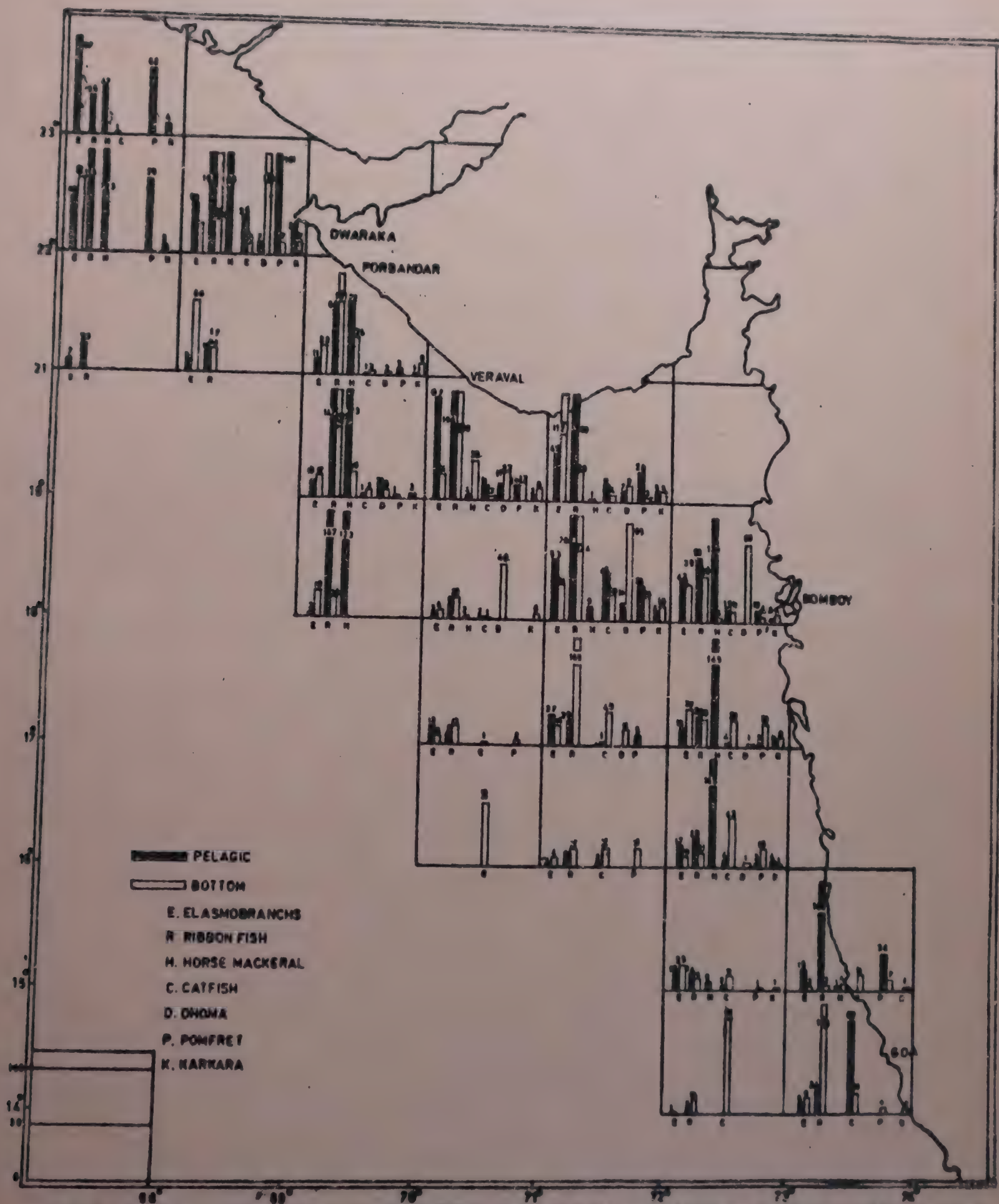


FIG. 6 AREA-WISE CATCH, CATCH PER HOUR OF EACH VARIETY IN THE TOTAL CATCH OBTAINED BY PELAGIC TRAWLING AND BOTTOM TRAWLING IN RESPECT OF M. T. MURENA'S VOYAGES DURING 1977

TABLE IX The catch composition, catch/hour and percentage of each variety in the total catch obtained by pelagic trawling along with bottom trawl data obtained by M.T.Murena in the course of six cruises

Species	Pelagic trawling			Bottom trawling		
	Catch (Kg)	Per- cen- tage	Catch/hr (Kg)	Catch (Kg)	Perce- ntage	Catch/hr (Kg)
Horse mackerel	1,69,730	38.90	159.4	2223	3.06	5.6
Ribbon fish	1,21,637	27.88	114.2	24,859	34.26	62.4
Elasmobranchs	35,716	8.19	33.5	8,501	11.72	21.3
Pomfret	28,743	6.59	27.0	1,820	2.51	4.6
Eel	13,759	3.15	12.9	1,349	1.86	3.4
Cat fish	14,900	3.42	14.0	5,749	7.92	14.4
Ghol	7,415	1.70	7.0	2,331	3.21	5.8
Karkara	3,432	0.79	3.2	1,377	1.90	3.5
Dhoma	3,853	0.88	3.6	7,549	10.40	18.9
<u>Chorinemus</u> spp	2,099	0.48	2.0	242	0.33	0.6
<u>Lactarius</u> spp	1,004	0.23	0.9	200	0.28	0.5
<u>Polynemus</u> spp	1,051	0.24	1.0	1268	1.75	3.2
Seer fish	4,276	0.98	4.0	173	0.24	0.4
Perch	2,078	0.48	2.0	2,609	3.60	6.5
Tam	709	0.16	0.7	22	0.03	0.1
Shrimp	630	0.14	0.6	117	0.16	0.3
<u>Caranx</u> spp	4,777	1.09	4.5	1,374	1.89	3.4
<u>L. nigra</u>	359	0.08	0.3	258	0.36	0.6
Barracuda	518	0.12	0.5	258	0.36	0.6
<u>Pellona</u> spp	243	0.06	0.2	951	1.31	2.4
Bombay duck	150	0.03	0.1	-	-	-
Rawas	137	0.03	0.1	40	0.06	0.1
Rani fish	258	0.06	0.2	3,078	4.24	7.7
Koth	30	0.01	0.0	-	-	-
Dara	12	0.00	0.0	65	0.09	0.2
Tuna	1,085	0.25	1.0	-	-	-
Squid	68	0.02	0.1	792	1.09	2.0
Others	17,630	4.04	16.6	5,359	7.39	13.5
TOTAL/AVERAGE:	4,36,299	100.00	409.6	72,564	100.00	182.0

In Ratnagiri region, ribbon fish and horse mackerel were found to be predominant, each constituting 26% and 22% respectively of the total catch. The other dominant groups in this region were elasmobranchs (17%) and pomfret (13%). On the contrary, demersal trawling in this region has shown cat fish predominating with 22% and elasmobranchs and perches occupying the next place with 11% of the total catch.

Ribbon fish accounted for about 40% of the total catch along the Bombay region. Eel, elasmobranchs and horse mackerel constituted about 10% each of the total catch. The percentage composition of the remaining groups were less than 5% of the total catch. The main constituents of the demersal catches in this region were ribbon fish 29%, dhoma 19%, elasmobranchs 12%, cat fish 6% and wam 6%.

Ribbon fish was the predominant variety in pelagic trawl catches in areas off Veraval constituting about 50% of the total catch. The same group predominated in the catches with 58% in respect of bottom trawling carried out by M.T.Murena during 1977. Elasmobranchs and horse mackerel were the next major groups recorded by M.T.Murena in both types of trawling.

Along Porbandar region, the bulk of catch by pelagic trawling was constituted by ribbon fish (38%) and horse mackerel (30%) whereas for bottom trawling ribbon fish accounted for about 36% and elasmobranchs (22%) which incidentally was the highest percentage for elasmobranchs amongst all the regions.

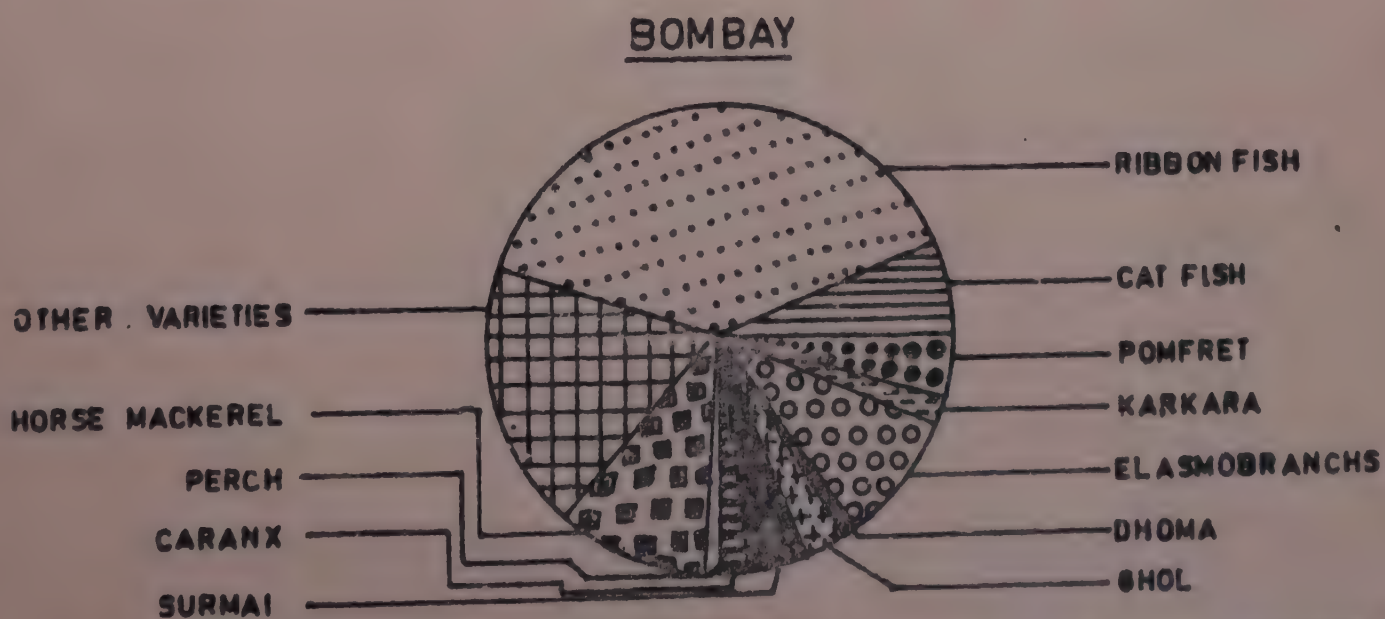
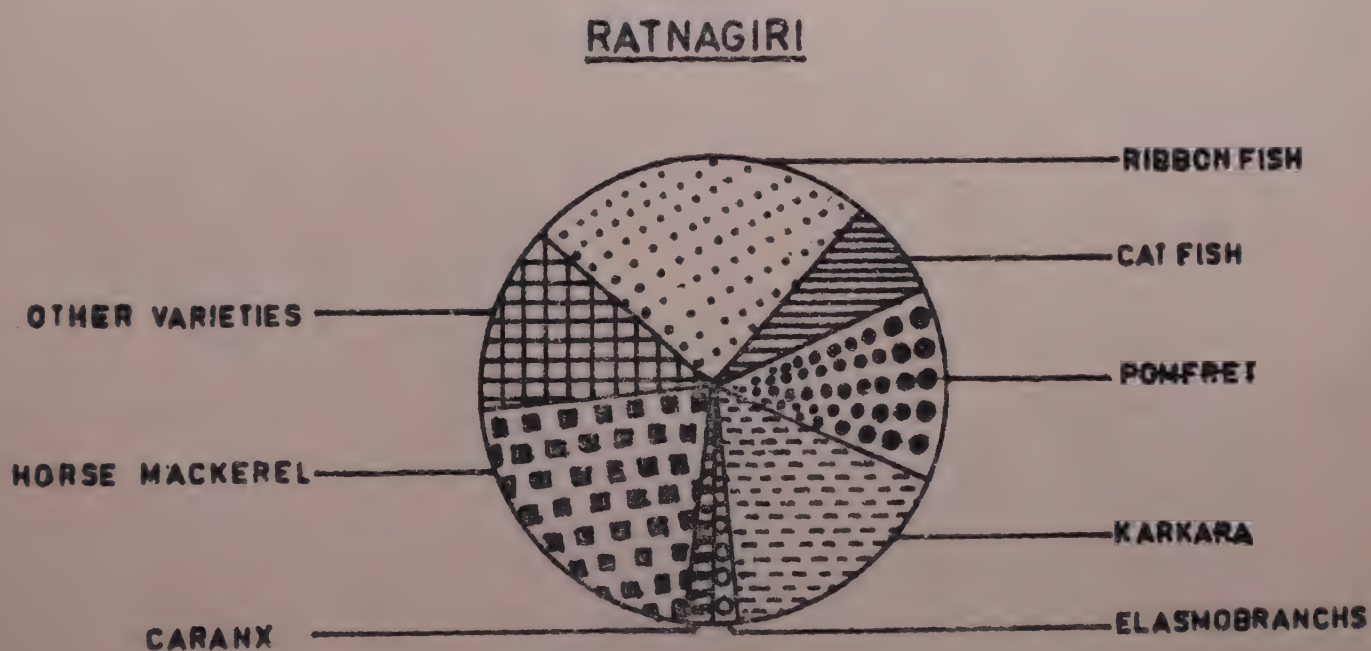
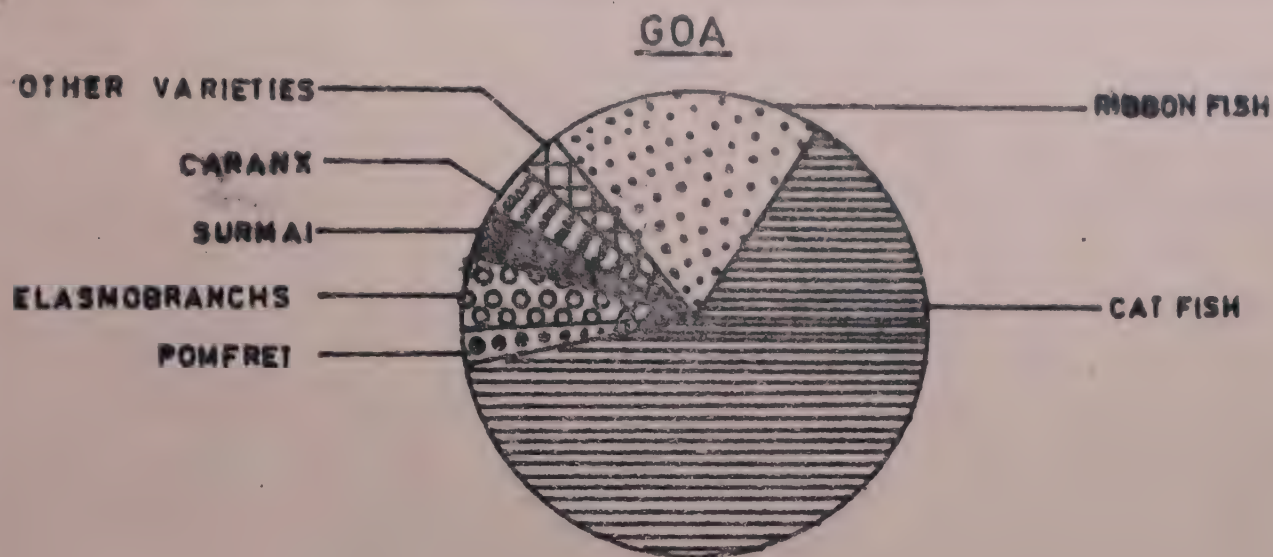


FIG.7 THE PERCENTAGE COMPOSITION OF IMPORTANT CATEGORIES OF FISHES IN RESPECT OF PELAGIC TRAWLING BY M.T.MURENA DURING HER 1st TO 6th CRUISES OFFGOA, RATNAGIRI AND BOMBAY REGIONS

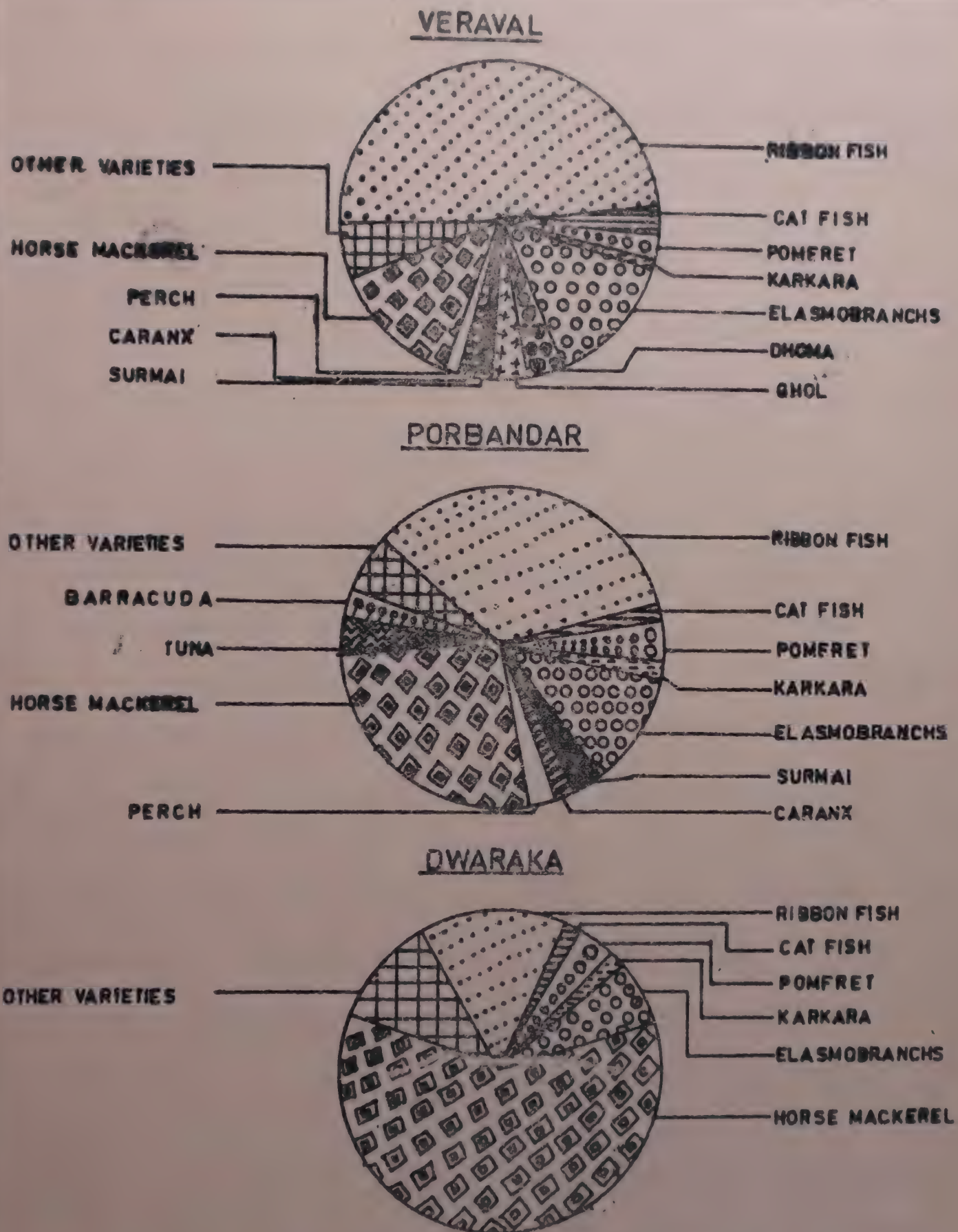


FIG.8 THE PERCENTAGE COMPOSITION OF IMPORTANT CATEGORIES OF FISHES IN RESPECT OF PELAGIC TRAWLING BY M.T.MURENA DURING HER 1st TO 3th CRUISES OFF VERAVAL, PORBANDAR AND DWARAKA.

Horse mackerel was the dominant variety in areas off Dwaraka constituting about 63% of the total landings. The horse mackerel landing recorded from this region appeared to be the ^{highest} ~~highest~~ compared to the other five regions along the North west coast. The other important groups netted in this region were elasmobranchs, pomfret and ribbon fish. It may also be noted that dhoma (sciaenids) contributed 55% of the total catch in respect of bottom trawling from this region.

The percentage composition of important groups of fishes in the total catch from the different regions in respect of pelagic trawling were as follows:

- Goa: cat fish(63%) and ribbon fish (18%);
- Ratnagiri: ribbon fish (26%), horse mackerel (22%) and elasmobranchs (17%);
- Bombay: ribbon fish (40%), eel (10%) and horse mackerel (10%);
- Veraval: ribbon fish (49%), elasmobranchs (13%) and horse mackerel (13%);
- Porbandar: ribbon fish (38%), horse mackerel (30%) and elasmobranchs(11%);
- Dwaraka: horse mackerel (63%) and ribbon fish (15%).

7.4. Relative abundance of important groups:

Fig. 8 gives the catch/hour of important groups obtained from different areas surveyed by M.T.Murena in respect of pelagic trawling. The figure gives a graphic representation of the relative abundance of some of the dominant groups to the aggregate catch from the relevant geographical divisions. Considerable variation was noticed in the catch rates of different varieties obtained from these areas. The trend of distribution of some of

the important categories is indicated below:-

RIBBON FISH: This variety was distributed in all the areas surveyed by M.T.Murena. The catch/hour ranged between 3 Kg and 309 Kg, the maximum being from the area 20-71 off Veraval. The second highest catch rate of 277 Kg/hr was recorded from area 19-71 off Bombay. Comparatively better catch rates were also recorded from area 20-70 (196 Kg/hr), 22-68 (195 Kg/hr) and 19-69 (171 Kg/hr). The areas from which a catch rate between 100-150 Kg recorded were 16-73, 20-69 and 22-67. The catch rates from the remaining areas were less than 100 Kg/hr. Generally speaking, the catch rate of this group was high in areas off Bombay, Veraval and Dwaraka.

HORSE MACKEREL: The occurrence of this variety was found restricted to areas between Bombay and Dwaraka. The highest catch/hour of 723 Kg was obtained from area 22-67 off Dwaraka followed by 145 Kg from area 18-72 off Bombay. The areas 19-69, 19-72, 20-69 and 22-68 also yielded catch rate of ~~about~~ 100 Kg/hr. The total absence of this species along the Goa region is significant.

ELASMOBRANCHS: The highest catch/hr of 97 Kg was obtained from area 23-67 off Dwaraka followed by 82 Kg from area 20-70 off Veraval. Comparatively better catch rates were also recorded from area 19-71 off Bombay, 20-70 off Veraval and 22-67 and 22-68 off Dwaraka.

POMFRLT: The regions Dwaraka, Bombay and Veraval yielded better catch rates for this variety of which the ~~area~~ ^{area} 22-68 off Dwaraka excelled with a catch rate of 101 Kg/hr. The area 22-67 (75 Kg/hr), 23-67 (62 Kg/hr), 19-71 (26 Kg/hr) and 20-71 (20 Kg/hr) were other productive areas for this variety.

CAT FISH: The highest catch rate of 88 Kg/hr was recorded from area 15-73 off Goa. Better catch rates for this variety was also obtained from the areas 19-71 (45 Kg/hr) and 22-68 (35 Kg/hr).

8. RESULTS OF OPERATION OF ANCILLARY VESSEL

M.T.Matsyavigyan of Exploratory Fisheries Project was the only vessel available for operation as ancillary vessel during the sixth cruise of M.T.Murena. The vessel conducted four voyages expending a total fishing effort of 152 hours. The catch landed was about 37 tonnes. During all the four voyages the vessel operated 45 m two-seam bottom trawl.

Table X gives the details of fishing effort put in and the catch/hour obtained from different areas. It can be seen from the table that out of the six areas surveyed, maximum effort was put in area 18-72 (53 hrs) followed by 17-72 (49 hrs) and 19-71 (36 hrs). The bulk of the catch was constituted by cat fish and elasmobranchs. The highest catch/hr for elasmobranchs (37 kg) was obtained from area 17-72, while the highest catch/hr (216 Kg) for cat fish was recorded from area 17-71. Pomfret was recorded from five areas except 19-72 and the highest catch rate was obtained from area 18-72 (11 Kg/hr).

Table XI presents the percentage composition of important varieties of fishes caught by M.T.Matsyavigyan. It may be seen that other than elasmobranchs and cat fish, karkara (31.5%) and tam (13.6%) were found in area 17-71; ribbon fish (11%) in area 19-71 and cuttle fish in areas 17-71, 17-72 and 19-71. Pomfret accounted for 1 to 6 percent in the six areas surveyed whereas seer fish was recorded only from two areas 18-72 and 19-71. The occurrence of cuttle fish in areas 17-71, 17-72 and 19-71 with catch rates 8 Kg/hr, 6 Kg/hr and 13 Kg/hr respectively is of special interest.

TABLE X

Area-wise catch/hour of important species obtained by M.T.Matsyavigyani

[illegible]

TABLE XI. Percentage composition of important species obtained by
M.T.Matsyavigvani

[illegible]

9. GENERAL OBSERVATIONS

An attempt is made in this chapter to assess the extent to which the objectives contemplated under the Indo-Polish agreement relating to the survey of fisheries resources along the north west coast of India, have been fulfilled during the one year of operation of M.T.Murena. The objectives of the survey were as follows:-

- A) To assess the nature, quality and quantity of commercially exploitable fishes and other living resources in the areas between latitude 15°N and latitude 24°N along the north west coast of India from 30 to 200 fathoms;
- B) To make available data for the preparation of feasibility report for the fishing industry with a particular reference to obtain assistance from financial institutions;
- C) To assess the factors contributing fluctuations in the availability of fish and other living resources mentioned above in time and space; and
- D) To raise national capability in fishing technology with reference to the resources and areas mentioned.

A.1. The industrial fisheries survey undertaken by M.T.Murena is the first organised survey for assessment of fishery resources beyond 50 fathoms depth along the north west coast of India. The vessel conducted bottom trawling and mid water/pelagic trawling in the area lying between latitude 15°N and latitude 23°N within the depth range of 30-200 fathoms in six voyages, each lasting for about 40 days. During the year 1977 the vessel was out at sea for 218 days and expended 1464 hours in fishing. The vessel made 247 bottom trawl hauls expending about 400 hours of actual fishing landing 72.6 tons of fish. The number of pelagic trawl hauls made

were 543 and the effort put in and the catch landed respectively being 1065 hours and 436.3 tons of fish. The catch/hour by bottom trawling and pelagic trawling for the entire period worked out to 182 kg/hr and 410 kg/hr respectively.

A.2. The nature, quality and quantity of commercially exploitable fishes and other living resources in the survey area has been studied in detail. Of the 22 major areas surveyed, 19-69 and 19-71 off Bombay and 22-67 and 22-68 off Dwaraka in depth ranges 30-70 fathoms proved to be potentially rich grounds in respect of pelagic trawling. The areas 22-67 and 19-69 yielded a catch rate of 1838 kg/hr and 1137 kg/hr respectively indicating that these areas have a very good potential to support mid water/pelagic trawl fishery. As for demersal fishery resources out of the 21 major areas surveyed, it is seen that 19-71 off Bombay in depth range of 30-50 fathoms excelled with a catch rate of 369 kg/hr. Seven other areas viz. 18-71 and 19-72 off Bombay, 20-71, 20-70 and 20-69 off Veraval, 21-69 off Porbandar and 22-68 off Dwaraka yielded catch rate between 200-300 kg/hr, thus revealing that the areas off Bombay and northwards were comparatively better than the areas south of Bombay for bottom trawling.

A.3. Of the two types of trawls operated, the pelagic trawl has proved to be more productive in the area of survey. The survey has thus highlighted the importance of pelagic/mid water trawling and the application of electronic fish detecting equipments for increasing the efficiency of fishing operations. Where the bottom conditions in some of the areas were found unfavourable for bottom trawling, it was revealed that pelagic trawling in such cases could be successfully employed by adjusting the depth of operation. This is an important aspect to be taken into account by the organisations engaged in exploratory survey work and training of operative staff, as well as agencies undertaking commercial fishing.

A.4. Pelagic trawling revealed the existence of sizable concentrations of horse mackerel and pomfret in the areas off Bombay and Gujarat in the depth range of 30-70 fathoms which can sustain commercial exploitation.. Catches upto 12 tons of horse mackerel and 6 tons of black pomfret per haul were netted in these areas during February/March. The areas off Dwaraka yielded a maximum catch rate of 1838 Kg/hr of horse mackerel. Ribbon fish available off Veraval, eel along the Bombay coast and cat fish along the Goa coast can be economically exploited. Location of productive grounds open up new possibilities of commercial exploitation in deeper waters. ~~It also indicated possible areas where large fishing vessels can be operated.~~

A.5. The biology of important species netted in the six regions along the north west coast of India during the different periods of the year in respect of both bottom and pelagic trawling has been studied in detail and will be published elsewhere. The important groups netted in the pelagic trawl are horse mackerel 44%, ribbon fish 26%, elasmobranchs 7%, pomfret 6%, eel 3%, cat fish 3% and ghol and carangids 1% each whereas for bottom trawling the bulk of the catch consisted of ribbon fish 34%, elasmobranchs 12%, dhoma 10%, cat fish 8%, perch 4%, ghol 3%, horse mackerel 3%, pomfret 3%, eel 2% and squids 1%.

A.6. Studies have revealed that the areas off Bombay and Dwaraka in depth range of 30-70 fathoms are very rich in pelagic/columnar fishery resources. Potentiality of bottom fish resources in the three depth zones viz. 30-50, 51-70 and 71-200 fathoms were examined. The catch/hour obtained from the above three depth zones were 195 Kg, 223 Kg and 68 kg respectively, which clearly shows that 51-70 fathoms range is comparatively more productive. It was found

that pomfret, karakara, dhoma and perch were distributed in 30-50 fathoms range off Bombay and Dwaraka. Cat fish, ribbon fish, squids and horse mackerel were present in 51-70 fathoms, whereas in regions 71-200 fathoms squids, elasmobranchs and perches were sparsely distributed.

A.7. Squids which are gaining commercial importance due to its export market was found available in appreciable quantities in bottom trawl catches off Goa and Ratnagiri which calls for intensive investigation in order to develop this fishery.

A.8. The evidence of small traces of juvenile prawn and tuna in the catches off Gujarat and Goa in the depth range 51-70 fathoms calls for an immediate intensive survey in these areas to assess the availability of these resources with a view for undertaking commercial exploitation.

A.9. During the voyages it was found that different varieties of low priced fishes were caught and it is necessary to develop appropriate technology for processing these fishes into suitable fish products. The new technology so developed should be able to deliver protein rich food products at low price to the common man.

A.10. It may be mentioned that this was the first time that such huge quantities of frozen fish were unloaded in the Indian coast by any vessel. This was also the first time that miscellaneous fishes were converted into fish meal on board a fishing vessel demonstrating profitable methods of fish utilization.

B. A detailed report on the survey results of M.T.Murena embracing all the scientific, technological and economic aspects is under preparation and will be submitted by the Polish team to the Government of India by June 1978 as per the agreement. Meanwhile, the data collected by the main and ancillary vessels have been made available to the fishing industry in the form of Reports 1 to 6 published by Exploratory Fisheries Project. In one of the reports, the feasibility studies with financial projection have been attempted in respect of Murena type vessel if deployed in Indian waters.

C. It was observed that during the North west monsoon the dissolved oxygen content of the deeper layers of water in the survey area was very low and consequently the catches were also poor. Studies on the influence of various hydrographic factors on fish catches are being made at different laboratories both in India and Poland and these will be brought out in due course.

D. About 19 scientists and 25 fishing technicians could avail the opportunity of participating in the voyages of longer duration and could gain the experience of working on board the larger trawler. The technicians got themselves trained in various fishing techniques, handling the different types of gear, especially the pelagic trawl, detection of fish concentration by electronic equipments on board, processing of catch on board, production of fish meal and handling of cargo etc. The survey programme has undoubtedly strengthened the national capability to operate large vessels for effectively exploiting the marine wealth of the seas around the country.

During the Indo polish industrial fisheries survey programme, five Indian trawlers viz. M.V.Meena Bharati and M.T.Matsya-vigyani of Exploratory Fisheries Project, M.V.Blue fin and M.V.Red Snapper of Central Institute of Fisheries Nautical and Engineering Training and M.L.Samudradevi of Integrated Fisheries Project took part as ancillary vessels. The vessels together fished for 124 days expending 684 hours and landed 150 tons of fish.

To conclude, it may be stated that the objectives of the survey have been fairly fulfilled. However, there are bound to be some gaps in the coverage of certain areas and these are to be identified when attempts will be made to explore the areas fully by large vessels fitted with modern electronic equipments for fish detection during the coming years. This will help to widen our knowledge of fishery resources along the north west coast of India.

10. REFERENCES ON THE FISHERY RESOURCES ALONG THE
NORTH WEST COAST OF INDIA

The need for comprehensive bibliographies on scientific and allied subjects for the benefit of research workers and fishery entrepreneurs has long been recognised. It is felt necessary to bring under this chapter all the available references on the resources survey undertaken so far, description of the various fisheries, prospects of exploration with a view to exploitation, future commercial prospects etc. along the north west coast of India. It is hoped that the interested entrepreneurs may acquaint themselves with the available scientific background information at hand. This chapter includes only references pertaining to the north west coast of India. Though no claim is made that the chapter is complete in all respects, every effort has been made to make it as exhaustive as possible.

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Name of Country:
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Slide No.	Lat.	Long.	N S E W	Date			Hr.	Depth to bottom	Surf. temp. °C	Mixed layer depth	Wind			Temperature			Weather	Cloud amount	State of sea	Max. temp.		Min. temp.		g																																																		
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SPECIES _____

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STATION _____

Lnth	Lnth	Lnth	Lnth
5	32	59	86
6	33	60	87
7	34	61	88
8	35	62	89
9	36	63	90
10	37	64	91
11	38	65	92
12	39	66	93
13	40	67	94
14	41	68	95
15	42	69	96
16	43	70	97
17	44	71	98
18	45	72	99
19	46	73	100
20	47	74	101-105
21	48	75	106-110
22	49	76	111-115
23	50	77	116-120
24	51	78	121-125
25	52	79	126-130
26	53	80	131-135
27	54	81	136-140
28	55	82	141-145
29	56	83	146-150
30	57	84	151-155
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